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NEW LASER PROTECTIVE GOGGLES

by

Yao Luping, Zhang Yifan

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By: /Yao Luping,/Zhang Yifan

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TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
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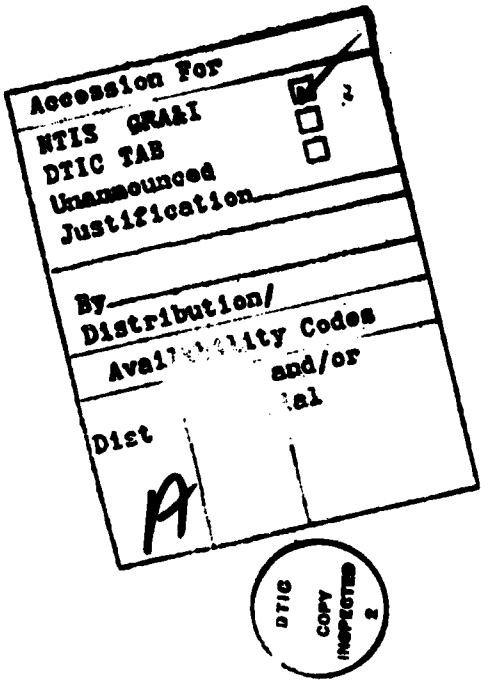

NEW LASER PROTECTIVE GOGGLES

Yao Luping, Shanghai Institute of Silicates
Zhang Yifan, Shanghai Naval Hospital

The extensive use of laser technology has aroused people's interest in laser protection. In order to carry on both research and the application of laser technology it is necessary that thcse who work with lasers are able to protect their eyes and still have a relatively clear field of vision. Iron doped high silica glass manufactured by the Shanghai Institute of Silicates of the Chinese Academy of Sciences can both filter out infrared and ultraviolet light and maintain clear visibility. This is the new type of eyeglass material which we wish to introduce.

The high silica glass containing Fe^{2+} and Fe^{3+} iron is a high silica porous glass which is made using sodium borosilicate glass which goes through a heat treatment phase and then acid treatment and leaching. Then the porous glass is dipped in a ferroaluminum ion solution and coil formed under reduced conditions into high silica glass containing Fe^{2+} and Fe^{3+}.

The characteristics of this type of glass are: it has special characteristics with respect to infrared and ultaviolet light absorption, i.e., transmission is 5% at 1.1 μm, but visible light range transmission is approximately 80%, and at wavelengths less than 0.33 μm all is blocked out (for specimens containing 0.76% iron and having a thickness of 4.5mm). Chemical stability and thermal shock

resistance are not much different from quartz glass. The softening point of the glass is above 1400°C and the linear expansion coefficient is approximately 8.6×10^{-7}. The reason why this type of glass has these kinds of properties primarily is a part of the Fe^{2+} and Fe^{3+} charge transfer absorption band, i. e., the absorption brought about by the electrons upon transfer between Fe^{2+} or Fe^{3+} and oxygen coordination. The charge transfer band intensity must be 100 - 1000 times greater than the allowed spin transition intensity between the 3d orbital energy levels of transition metal ions. The center of the charge transfer absorption band of the Fe^{3+} in silicate glass lies at 230 nanometers and the molar extinction coefficient is 7000. In the ultraviolet region Fe^{2+} also has a charge transfer absorption band. Its center lies at 210 nanometers and the molar extinction coefficient is 3000.

In the light of investigation of the optical spectrum and the Mossbauer effect, we hold that the Fe^{3+} in silicate glass lies at coordinate four.

Sometimes a milky-white film appears in the inner layers of the glass and determination by x-ray line powder diffraction reveals that it is low temperature cubic quartz and its presence can lower the percent of visible light transmission of the glass.

(Submitted 19 March 1981)

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